CHAPTER 7

AGRICULTURE

FARMING

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FARMING

BMP 7-1
IRRIGATION WATER MANAGEMENT

DEFINITION

A broad system or scheme for controlling, applying, and removing irrigation water on the farm in a planned and efficient manner. The elements of an irrigation water management system may include:

1. **Water Measuring Devices** - Structures, such as weirs, flowmeters, flumes and open pipe discharges to measure flows.

2. **Water Control Structures** - Permanent structures, such as diversion boxes, checks, turnouts, pipes, or drops which provide positive control of in-system diversion of the irrigation stream.

3. **Regulating Reservoirs** - Relatively small basins constructed at the head of the irrigation system to regulate a fluctuating supply or for temporary storage to provide a larger, more efficient flow of water for irrigation. Regulating reservoirs can be used as desilting basins when operated in conjunction with a tailwater recovery system.

4. **Tailwater Recovery System** - A system of channels, sumps or small reservoirs, pipelines, and/or pumps which will return the drainage water (surface or subsurface) to the irrigation distribution system for reapplication.

5. **Land Grading** - Reshaping of the land surface to provide a uniform or complex slope for efficient, uniform surface irrigation and drainage.

6. **Land Smoothing** - Removing land surface irregularities, such as small ridges and closed depressions, to provide complete drainage of the land surface.

7. **Surface Irrigation System** - A system of facilities designed and constructed for the efficient distribution of irrigation water to the cropland by surface methods such as corrugations, furrows, border checks, basin, contour checks, ditches, wildflooding, drip irrigation, sprinkler and underground pipe. The system should be designed for the most efficient irrigation flow and optimum irrigation run.

PURPOSE

Efficient, economical control of the irrigation and drainage water on the farm is done to: satisfy crop irrigation and soil leaching requirements; maintain soil conditions for suitable plant growth; and prevent degradation of surface and ground water quality. The principal water quality parameters to be considered are suspended solids, dissolved solids, nutrients, biocides, pesticides, herbicides, biological oxygen demand, temperature, pH, and coliform bacteria.

APPLICABILITY

Applies to all irrigated land on which a conservation irrigation system has been developed.

PLANNING CRITERIA

In planning for irrigation water management, consideration should be given to other BMPs, including salinity control, water conveyances, and appropriate conservation crop production elements.

Planning criteria include the following:

1. All facilities and their use, including the diversion and discharge of irrigation water, must conform to the applicable federal, state and local water laws and environmental regulations.

2. General irrigation system design considerations include: soil (agricultural and foundation) characteristics, crop water requirements, topography, material availability, irrigation and drainage water flow paths, farm management capabilities and a cost benefit analysis.

3. Specific determinations are necessary for proper irrigation water management including: water application amount and rate, leaching requirement, system capacities, optimum slopes and/or hydraulic gradients, facility sizes and configuration, time of irrigation set, and uniformity of application.

4. Know the amount that should be applied. Schedule irrigations to meet crop requirements plus a minimum leaching fraction. This will result in improved irrigation efficiencies.

5. Apply water as infrequently and for as long a duration as proper irrigation scheduling will allow. This will minimize total erosion and runoff.

6. Apply water uniformly. This will involve flow measurement, careful land grading (slope), optimum length of run and good design and operation for sprinkler and drip systems.

7. Avoid applying fertilizers, biocides, or amendments in the irrigation water when runoff cannot be confined to the farm.

8. Develop a tailwater recovery system including an adequate drainage system.

9. Utilize sediment retention basins. These can be specific basins, regulating reservoirs, or small basins created by checks in the drain ditches.

10. Utilize vegetated buffer strips or drainageways. Another alternative is to use runoff from row crops to irrigate close growing crops.

11. Since land varies in requirements for irrigation water management, consideration should be given to the identified irrigation land treatment groups described in the Appendix F.

METHODS AND MATERIALS

Since irrigation water management is defined, in effect, as a system of physical facilities for water control, it is necessary that the facilities be constructed of dependable materials and installed properly for proper operation. The materials should be native and/or fabricated which have been determined acceptable by previous experience, testing, or warranty.

A principal objective of irrigation water management is control of the water quality in the downstream receiving waters. The methods suggested in this section for achieving water quality control involve the use of appropriate elements of the system. The design considerations for these elements are discussed in Appendix F.

The degradation of receiving waters is a result of, or associated with, surface runoff from the farm. Following are management methods for controlling this runoff. The degree of control will depend upon the extent and/or practicability of their implementation.

1. **Sprinkler Irrigation System** - A designed and constructed system for the efficient application of irrigation water under pressure through pipelines and above ground nozzles or orifices.

2. **Drip Irrigation** - A designed and constructed system for the efficient application of irrigation water to the land at a low pressure and rate to individual or groups of plants, at or near the soil surface, through a system of pipelines and emitters.

3. **Surge Irrigation/Corrugation** - A system designed to do repeated wetting of irrigated lands in surges and thus reducing the potential for field runoff.

MAINTENANCE

A regular inspection and maintenance program should be developed and implemented to keep the irrigation system or systems operating at its optimum. Repairs and the replacement of system components should be completed as required.

EFFECTIVENESS

Each of the elements and methods of this practice are effective. The degree of total effectiveness will depend upon the extent that they are properly implemented and managed.

BMP 7-2
IRRIGATED CROPLAND MANAGEMENT

DEFINITION

The use of irrigated cropland for crop production and management of soil and water resources.

PURPOSE

To provide for sustained production of agricultural crops, protect the soil from erosion and maintain or improve water quality.

APPLICABILITY

Applies to all irrigated cropland.

PLANNING CRITERIA

The specifics of the site will govern the development of an irrigated cropland management system. Consideration should be given to soil characteristics, topography, surface drainage, farm management capabilities and the relative cost effectiveness of various management techniques.

METHODS AND MATERIALS

The following are suggested cropland management techniques which may be tailored to the specifics of the site.

1. **Conservation Cropping System** - A cropping system that includes crops that produce plant residue adequate to maintain organic matter and soil tilth. Perennial legume or grass-legume, hay or meadow crops in the system are very effective conservation treatments. Close growing small grain crops and mulching can sometimes be substituted for hay or pasture in a cropping system.

2. **Minimum Tillage** - A tillage system that leaves the crop residue on the soil surface or partially incorporated into the surface soil. Use subsurface tillage equipment and till only enough for weed control and seedbed preparation. Special planting equipment designed for planting in residue may be needed for some crops. Grass-legume crops may be seeded directly into small grain stubble with no tillage if weed control has been adequate in the grain crop. Cultivate intertilled row crops only as needed. The proper use of herbicides for weed control will reduce the need for tillage. Additional nitrogen fertilizer above normal application rates may be needed for residue decomposition.

Care must be taken to avoid over fertilization to the extent that runoff or excessive leaching occurs. Fertilizer amounts and application timing should be well planned to minimize the potential for surface or ground water contamination.

3. **No Till** - A tillage system that leaves the crop residue on the soil surface for maximum protection against soil erosion.

4. **Cover Crops** - Plant cover crops to protect the soil from wind and water erosion following clean tilled row crops, on land laid bare by land leveling, or on development of new lands prior to establishment of the initial crop or cropping system. In development of new land irrigation water should be available for establishing cover crops.

   Small grains are good cover crops. Rapid developing grasses and legumes like ryegrass and annual sweetclover can also be used. On soils where it is adapted, sudangrass is a good cover crop plant for summer seedings. Fertilize and irrigate as needed for rapid development of the cover crop. Use minimum tillage procedures to work down cover crop residue.

5. **Green Manure Crops** - Green manure crops are used when the cropping system does not produce adequate plant residue for soil protection or to maintain soil tilth. Hairy vetch, common vetch, sweetclover, rye or other small grains make good green manure crops. If possible, green manure crops should be worked down with minimum tillage procedures.

6. **Mulching** - The application of plant residues not produced on the site, barnyard manure, or other suitable materials to cropland for erosion control during critical periods. These are usually applied only on small critical areas such as ridgetops or blowouts. Hay straw, manure, cornstalks or other plant residues can be used. Application rates should be adequate to provide the needed soil protection. Hay and straw mulches should be anchored by punching them into the soil surface.

7. **Fertility Management** - Apply fertilizer based on soil tests, agency recommendations and local practice. Excess fertilizer may cause nutrient pollution by runoff or deep percolation.

8. **Pest Control** - Use a combination of cultural, biological and chemical control measures. Apply pesticides in accordance with labeled instruction registered with the Nevada Department of Agriculture or in accordance with specific regulations of the department. Always read the label on the pesticide container before using the material.

9. **Diversions** - Install diversion dikes or ditches to divert excess offsite runoff waters away from cropland to suitable drain outlets. (See Appendix A - Erosion and Sediment Controls.)

10. **Grassed Waterway** - Install grassed waterways where needed to conduct runoff water through cropland. (See BMP - 2-11 "Grassed Waterways and Outlets").

11. **Irrigation and Drainage Systems** - Install adequate irrigation and drainage systems adapted to soils and crops. (See Appendix F - Agriculture - Farming).

12. **Irrigation** - Use irrigation water management specific for the soil and crops grown. (See BMP - 7-1 "Irrigation Water Management").

MAINTENANCE

Maintenance of the cropland management system will be done through normal tillage and crop culture operations. Additional maintenance will be required to keep irrigation and drainage systems in effective operating condition.

EFFECTIVENESS

Application of a cropland management system that includes the necessary components for the specific soils and crops will maintain the soil resource for sustained crop production and maintain or improve water quality.

BMP 7-3
NATIVE MEADOWLAND IRRIGATION MANAGEMENT

DEFINITION

A planned irrigation system where all necessary water control structures have been installed for the efficient distribution of irrigation water by surface means. Determining and controlling the rate and amount of irrigation water application to soils for crop water requirements in a planned and efficient manner.

PURPOSE

To effectively utilize available irrigation water in managing and controlling the moisture requirements of native hay and pastures; to promote the desired growth response; to minimize soil erosion and loss of plant nutrients; to control undesirable water loss, and to protect water quality.

APPLICABILITY

This practice is adapted to all native meadowlands that are suitable for irrigation and that have a water supply of suitable quality and quantity.

PLANNING CRITERIA

The layout of a ranch irrigation system should provide for the conveyance and distribution of irrigation water without sustaining soil erosion. All ditches should be located on non-erosive gradients and include the necessary water control structures. Land shaping for proper water distribution should be done in a manner that will least disturb the meadow vegetation. Disturbed areas should be reseeded. Ditches and other structures must be designed and constructed to allow delivery of required quantities of water. They should be designed for the maximum flow conditions that are to be expected.

Irrigation delivery systems should be located out of muck and silt areas to less erosive soil types on higher ground. Stream channels should be re-located only after careful planning. The channels should be re-shaped so that the banks can be stabilized with vegetation.

Identification of existing stable channels in the area is a good guide for shaping and layout of new channels.

Maintaining fisheries within stream channels should be a high priority and irrigation diversions should be designed to maintain an instream flow that will support fish requirements.

METHODS AND MATERIALS

Native meadowland irrigation management is defined, in effect, as a system of physical facilities for water control; therefore, it is necessary that the facilities be designed and constructed properly. A principal objective is the control of the water quality in the downstream receiving waters. The methods suggested in this section for achieving water quality control involve the use of appropriate elements of the system. The design considerations for these elements are discussed in the Appendix F - Agriculture - Farming.

MAINTENANCE

Snag and debris removal from creek beds and ditches is usually an annual project which helps to maintain water in the channels and alleviate uncontrolled surface flow and soil erosion. Snag and debris removal must be conducted in a manner which does not impact the fisheries and wildlife values of the creek. Please refer to BMP 6-3 for additional information.

EFFECTIVENESS

Irrigation management will maintain meadow production, control soil erosion and improve water quality.

BMP 7-4
PASTURE & HAYLAND MANAGEMENT

DEFINITION

The use of haylands and pasturelands for improved forage production and management of soil and water resources.

PURPOSE

To provide for sustained forage production, protect the soil from erosion and maintain or improve water quality.

APPLICABILITY

Applies to all lands used for the production of hay and/or pasture.

PLANNING CRITERIA

Develop a management system for sustained forage production and land treatment practices suited to soil and site conditions.

METHODS AND MATERIALS

1. **Hay and Pasture Planting** - Plant hay and pasture lands to adapted forage species. Follow joint recommendations of the University of Nevada Agricultural Extension Service, U.S.D.A. Soil Conservation Service and other cooperating agencies. Lands cleared for pasture and hayland development must be treated as needed for erosion.

2. **Harvest Management** - Cut hay crops when plants are at the proper growth stage for high yields and good quality. Defer grazing of new pasture seedings until plants are well established. Allow adequate plant growth in the spring before starting grazing (six to ten inches of growth). Use a rotation grazing system with adequate regrowth time between grazing periods. Always leave sufficient plant residue to protect the soil from erosion and excessive runoff. Scatter manure with harrow or brush drag.

3. Fertilize according to agency recommendations, soil tests, and plant species requirements. Excess fertilizer may cause nutrient pollution in surface runoff or ground water.

4. Install irrigation and drainage systems adapted to the soil, site and water supply. (See Appendix F - Agriculture - Farming)

5. Control shrub invasion on native pasture and haylands.

6. Install diversion dikes or ditches as needed to divert excess irrigation runoff.

7. Install grassed waterways where needed to carry runoff waters.

8. Use no till seeding whenever possible.

MAINTENANCE

Manage grazing, harvesting, irrigation and fertilization to maintain a healthy plant community and a stable site.

EFFECTIVENESS

Using lands for production of hay or pasture under proper management will significantly decrease runoff and sediment delivery. Proper fertilizer practices will not adversely affect water quality.

BMP 7-5
SALINITY CONTROL

DEFINITION

The design and implementation of land and water management practices with the objective of reducing salt concentration in surface runoff and ground water.

PURPOSE

To maintain soil conditions suitable for plant growth while preventing degradation of downstream surface and ground water quality by excessive salt concentration.

APPLICABILITY

Applies to all irrigable land. However, the applicability to land with a high water table will be dependent on establishment of adequate surface drainage and the development of an acceptable drainage effluent disposal system.

PLANNING CRITERIA

In planning for salinity control, consideration should be given to other BMPs, including irrigation water management and appropriate conservation crop production elements.

Specific site characteristics that should be considered are:

1. Quality of receiving waters (stream and/or ground water).
2. Quality of irrigation water.
3. Salt content throughout soil profile.
4. Soil water-holding capacity and cation exchange capacity.
5. Topography.
6. Presence of a high water table.
7. Potential use of receiving waters.
8. Subsurface drainage.

METHODS AND MATERIALS

Since the purpose of salinity control is non-degradation of downstream water quality, the amount of salts leaving the site should be minimized. This means the principal treatment for excess salts is to leach the salts into the soil profile area below the rooting depth of the crop. However, in the instance where a high water table exists, requiring subsurface drainage and where continued reuse of the effluent builds salts in the soil close to the tolerance of even salt-tolerant crops, increased salt discharge will be unavoidable.

Practices that will effect some degree of salinity control are listed below. The greatest control will most often be achieved by a combination of practices. Two situations are considered: non-high water table areas and high water table areas. (High water table means the existence of a water table in the normal rooting zone of the crop.)

Non-High Water Table Areas

1. Adopt some form of irrigation scheduling. Apply only enough water to satisfy the crop irrigation requirement plus a calculated amount necessary to move excess salts below the root zone but not into the ground water.

2. Develop or modify the irrigation system so that the best possible water control and distribution can be achieved. The type of system will depend upon the topography, soil characteristics, and crop types.

3. Develop a tailwater recovery system. The extent of reuse and/or discharge will have to be compatible with receiving stream water quality and applicable water rights.

4. Develop a cropping system compatible with salinity control objectives. Factors of importance include amount of crop residue, rooting characteristics, nutrient requirements, and relative salt tolerance.

5. Where sodium-affected (greater than 15 percent of cations) or high pH soils occur, the appropriate soil amendment should be applied and incorporated into the soil. Amendments may include gypsum, soil sulphur, sulfuric acid, and organic material. The appropriate amendment and rate will be determined by soil analysis, local practice, and technical recommendations.

6. A minimal quality monitoring program, including receiving stream, surface runoff, and soils would be beneficial. This may be more practical on an area wide basis using "typical" cooperators.

High Water Table Areas

The practices mentioned above are appropriate for the high water table situations except for the type of drainage system and the management approach taken in utilizing irrigation scheduling. A subsurface drainage system may be developed in conjunction with the tailwater recovery system.

In high water table areas, irrigation scheduling concepts may be used to reduce the water applied to a crop by using a portion of the ground water to meet crop needs. Crop tolerances to salt will dictate how much applied water can be reduced and the degree of salinity control possible.

The amount of reuse will be determined by the extent of long term salt buildup in the unsaturated soil zone and in the drain effluent. At some point in time, discharge of the drain effluent may be necessary. This discharge should occur prior to the time that the salt concentration in the drain effluent exceeds that in the receiving stream, and/or off season leaching could be performed with direct discharge into the stream during high flows.

MAINTENANCE

Design and implement a regular preventive maintenance program for all facilities to ensure good, dependable operating conditions. Repair and replace facilities and system components as necessary. Periodically sample soils, drainage waters, and receiving streams. Regularly re-evaluate farm operation management including facilities and cropping patterns based upon monitoring data.

EFFECTIVENESS

The level of effectiveness will depend upon the extent that the practices are implemented. A high degree of downstream water quality control can be achieved by using all applicable practices at the specific site.

ASSISTANCE

Assistance in irrigation scheduling can be obtained from the U.S. Soil Conservation Service, and the Cooperative Extension Service.

BMP 7-6
CHISELING OR SUBSOILING

DEFINITION

Breaking up shallow, impervious layers in soils.

PURPOSE

To improve water infiltration, plant root penetration, and for protection from wind erosion.

APPLICABILITY

Applies to soils on cropland, hayland, or pastureland having impermeable layers.

PLANNING CRITERIA

Chiseling is used on soils with shallow impervious layers. Subsoiling is usually needed with deeper impervious layers. For maximum benefit, the penetration must extend completely through the impervious layers.

METHODS AND MATERIALS

Heavy duty equipment with sturdy shanks long enough to reach the desired depth is required along with a tractor of adequate power.

MAINTENANCE

It may be necessary to repeat the operation periodically, especially on clay soils that tend to flow back together. Proper cultivation can prevent the reforming of plowpans.

EFFECTIVENESS

Breaking up of impervious soils will improve water penetration and plant growth. Proper chiseling will effectively reduce surface erosion.

BMP 7-7
SOIL AMENDMENT, FERTILIZER & PESTICIDE MANAGEMENT

DEFINITION

Application of soil amendments, fertilizers and pesticides to cropland, hay and pastureland, rangelands or forest land for increased production and/or control of pests.

PURPOSE

To supply nutrients and/or biological or chemical soil amendments to promote optimum forage and crop yields, minimize entry of nutrients and chemicals to surface and ground water, and to control pests.

APPLICABILITY

This applies to lands where soil amendments and/or fertilizers are applied to increase productivity. Pesticides are applied for pest control.

PLANNING CRITERIA

1. Evaluate water quality standards and designated use limitations that exist locally or statewide in managing nutrients to protect the quality of water resources.

2. Evaluate sources and forms of nutrients available for plant growth and production and how they affect the nutrient budget for the proposed crop and target yield.

3. Consider the effects of the seasonal water budget on nutrient balance and on potential loss from the plant environment to surface or ground water. These effects will be the basis for developing the nutrient management plan for the practice application.

4. Consider legume cover crops or green manure crops, where feasible, to provide a nitrogen source for the next crop. Be sure to consider these effects in the nutrient budget.

5. Develop soil erosion control practices to reduce soil loss, runoff, and leaching of dissolved and attached nutrients.

6. Consider adjustments to rate, timing, placement, method of application, and nutrient form to meet seasonal variations in plant uptake needs, reduce soil fixation, and to avoid excessive soil-water solution nutrient concentrations that could leach out of the root zone when capacity is exceeded.

7. Consider induced deficiencies of nutrients due to excessive levels of other nutrients, the affect of soil pH on the availability of both soil and applied sources of plant nutrients and the optimum pH range of the crop to be grown.

8. Consider soil tilth and organic content in relation to plant nutrient absorption and root development should be considered.

9. Consider cover crops following crop harvest, where appropriate, to take up residual nutrients.

10. Consider practices such as crop rotations, selection of crop varieties, waste utilization, etc., that enhance efficiency of nutrient uptake and improve soil water conditions.

11. Consider waste storage and treatment needs to meet application timing as well as land area requirements for proper waste utilization.

12. Evaluate the effect of water table management or controlled drainage on availability and movement of nutrients.

13. Apply only those pesticides specifically approved for the crop, animal, or site specified on the label in accordance with labeled instructions registered with the Nevada Department of Agriculture. Always read the label on the pesticide container before using the pesticide.

14. Use pest control techniques that utilize Integrated Pest Management (IPM) systems. These include the use of pest predators or parasites, pest resistant plants, the use of insect pheromones, and the use of bacterial insecticides, to name a few. Utilizing this type of IPM approach could reduce reliance on the amount of pesticides used on a per acre basis.

15. Properly locate chemical mixing and equipment rinsing stations relative to potential for contamination of ground or surface water. Extreme care must be taken to follow loading and mixing procedures. Provide for managing accidental spills.

16. Properly rinse equipment and re-use rinse water for subsequent batches of the same pesticide or herbicide, where possible.

17. Store pesticides in original containers in a locked, well ventilated, weather resistant building. Post warning signs on or around the building. Locate the building so that accidental spills will create minimal environmental effects. Dispose of pesticide containers according to label directions and adhere to local or state regulations.

18. Provide emergency wash stations for personnel who might be accidentally exposed to chemicals, and formulate a safety plan complete with information about locations of emergency treatment centers for personnel exposed to chemicals.

19. Ensure that backflow prevention devices are installed and operating properly on irrigation systems used for applying pesticides.

METHODS AND MATERIALS

1. Nutrient rates applied to agricultural land shall be based on soil test results, where applicable. Frequency of soil tests and/or plant tissue tests shall be specified.

2. Establish realistic yield goals based on soils, available moisture, historical yield data, climatic conditions, and the level of management necessary to minimize potential nutrient loading of surface water and ground water.

3. Develop a nutrient management plan for the crops to be grown. Account for the residual amount of nutrients in the soil and crop residue, add estimated nutrients from anticipated organic waste applications, and then determine the amount of chemical fertilizer needed to meet the nutrient needs of the proposed crop and target yield. Specify the crop, crop rotation, the type, source, and amount of plant nutrients that will be used to meet the crop fertility needs.

4. If non-farm organic waste is to be used, it shall be analyzed for content and applied as prescribed by federal, state, or local regulations. Appropriate documentation of the amounts applied should be maintained.

5. Livestock waste shall be analyzed prior to land application to establish nutrient credits and application rates.

6. Credit for nitrogen contributions from legume crops in rotation shall be consistent with current land grant university recommendations.

7. Develop a water budget that will describe the seasonal distribution of water resources under the appropriate soil-crop-management system.

8. Use the "Leaching Index for Soluble Nutrients" procedure or other detailed guidelines from land grant universities to evaluate groundwater pollution potential in conjunction with the water budget for the location.

9. All specifications will be consistent with the water and local regulations.

10. When using pesticides, follow all label directions. If assistance is necessary in choosing a particular pesticide ask a pesticide supplier and/or a technical assistance agency for their recommendations. **Follow any county specific limitations on pesticide use. Use only pesticides that are registered for use in the State of Nevada by the Nevada Division of Agriculture**.

MAINTENANCE

Follow up fertilizer applications may be needed to maintain fertility on cropland, hayland and pastureland. Site specifics may dictate additional soil amendments, fertilization and pesticide application.

EFFECTIVENESS

Using recommended rates and application procedures for fertilizers and pesticides will provide improved forage and crop production with little or no detrimental effects on water quality.

LIVESTOCK

BMP 7-8
PLANNED GRAZING SYSTEM

DEFINITION

A livestock/wildlife grazing system in which two or more grazing units are alternately deferred or rested from grazing in a planned sequence over a period of years. The rest period may vary in duration given the specifics of the grazing area (i.e. season, year, etc.).

PURPOSE

1. To maintain or improve plant cover, plant composition and forage production while properly using the forage on all grazing units.

2. To improve efficiency of grazing by uniform use of all parts of each grazing unit.

3. To provide a supply of forage throughout the grazing season.

4. To improve the quality of forage available to animals during specific seasons.

5. To protect watersheds, reduce runoff and sedimentation for the improvement of surface and ground water quality.

6. To improve wildlife habitat.

APPLICABILITY

Applies to native grazing lands, including those treated by spraying, seeding, etc., grazable woodlands and grazed wildlife lands. Grazing management may be applied to a single grazing unit and may be adequate to meet water quality objectives where proper grazing use and uniform distribution can be obtained.

PLANNING CRITERIA

The grazing system plan should:

1. Consider the climate, soils, range sites, present vegetative conditions, topography and other ecological conditions.

2. Allow forage use allocation for livestock and wildlife.

3. Be coordinated among all effected interests and natural resources. A "watershed" view should be established to identify all of the resources and interests. The coordinated approach should include federal land management agencies, state agencies, private land owners, other grazing users and applicable special interest groups. A variety of Resource Management and/or grazing systems are available given the specifics of the site including Holistic Resource Management, Coordinated Resource Management, and Savory Grazing Systems, to mention a few.

4. Consider specific management measures to alleviate livestock distribution problems such as concentrated use of riparian areas or other critical areas.

5. Should consider the kinds of livestock and the operator's objectives in conjunction with the federal land management objectives if the plan involves public lands.

6. Allow for practical application of the system and be flexible enough to meet the needs of key plant species and communities in relation to climatic fluctuations.

7. Consider the facilities needed for proper distribution and uniform use of grazing units such as fences, stock water developments, stock trails, access roads, salt, and supplemental feeding stations.

8. Provide for prolonged drought or other unusual circumstances. A monitoring plan should be included which monitors plant species use and condition with respect to the desired condition.

9. Consider economic costs in relation to the benefits expected from the entire system.

METHODS AND MATERIALS

1. **Grazing Management Systems** - Appropriate grazing management systems ensure proper grazing use by adjusting grazing intensity and duration to reflect the availability of forage and feed designated for livestock uses, and by controlling animal movement through the operating unit of range or pasture. Practices that accomplish this include:

   A. Deferred grazing - usually is defined as the postponing or resting of livestock grazing on an area for a prescribed period to provide for plant reproduction, establishment of new plants, or restoration of vigor to existing plants.

   B. Deferred-rotation grazing - Provides for a systematic rotation of deferment among two or more units.

C. Rest-rotation grazing - Provides for adequate rest to restore and maintain plant vigor, reduced trampling of mature seeds after plant maturity, and establishment of seedlings. Grazing and rest are systematically rotated until all pastures within the system have received treatment. Rest periods may be throughout the year, during the growing season of key plant species or may include one full year of rest.

2. **Livestock Distribution** - Proper distribution of livestock is needed for the efficient and uniform use of each grazing unit. A livestock operator can implement the management practice of herding or moving livestock when the desired plant use has been attained in a given area:

A. Fencing - Fences are usually required for livestock control and to divide ranges into grazing units of near equal capacity. Fences are also needed to exclude livestock from sensitive or critical areas. (See Appendix G-5 for fencing guidelines and specifications)

B. Stockwater Developments - It is essential to provide adequate water for livestock within reasonable distance of the grazing areas. Implementation of an improved grazing system often concentrates livestock requiring development of new or higher capacity watering facilities. In some applications water alone can be controlled to move livestock from one area to another.

There are several methods of developing stock water, including:

(1) Spring developments - Improving springs and seeps by excavating, cleaning, capping or providing collection and storage facilities.

(2) Wells - Constructed or improved to meet the needs of livestock and wildlife.

(3) Stockwater ponds and dugouts - A water impoundment made by constructing a dam or an embankment, or by excavation of a pit or dugout.

(4) Pipelines, trough or tank - Pipeline to convey water to areas with no water source and a trough or tank for storage.

(5) Photovoltaic pumping systems.

(6) Ram pumps.

(7) Windmills.

C. Stock Trails - May be needed where natural or man-made barriers limit access and movement of grazing animals. (See Appendix G-4 for guidelines and specifications for stock trails)

D. Salt, Mineral and Feed Supplement Locations - These need to be properly placed for good distribution of grazing animals throughout each grazing unit. They may be placed in light use areas away from water.

3. **Access** - It is necessary to have good access to all grazing areas for livestock management and to service and maintain facilities. Refer to NRS.535.010 on permit requirements for stock watering ponds and dams.

MAINTENANCE

Proper grazing use will maintain enough live vegetation and litter cover to protect the soil from erosion; will achieve riparian and other resource objectives; and will maintain or improve the quality, quantity and age distribution of desirable vegetation. Maintain fences and other facilities for efficient operations. Follow proper grazing use, that is, grazing at an intensity that will maintain plant cover and maintain or improve the quantity and quality of desirable vegetation. Adjust system plans based on inspection and records of utilization.

EFFECTIVENESS

A properly operated grazing system provides for efficient use of forage and is an effective means of maintaining a plant cover that will reduce runoff and sediment delivery. How effective grazing management will be is dependent upon both the quality of the design in relation to the land and the skill utilized to implement, monitor and adjust management to meet objectives.

BMP 7-9
PROPER GRAZING USE

DEFINITION

Utilizing grazing practices at an intensity which will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation.

PURPOSE

To improve or maintain the condition of a plant species or community; to improve vegetative ground cover; and to maintain or improve the quality of surface runoff water on upland areas. In riparian areas, the purpose is to provide minimum vegetation stubble height to slow runoff, trap sediment, and ensure adequate root mass to hold banks during spring run off events.

APPLICABILITY

On all rangeland, woodland, pasture land, wetlands, riparian areas, and cropland utilized for livestock or wildlife grazing.

PLANNING CRITERIA

Specific grazing or allotment plans should consider the following:

1. Grazing frequency;

2. Stocking rates and distribution;

3. Class and age of livestock, wildlife or free roaming horses or burros;

4. Season of forage use and the duration of each rest and grazing period;

5. Historic and/or prior livestock distribution problems including areas with concentrated use or overuse and areas where forage has remained unused.

6. Manager preferences for plant species, the abundance of those species and the forage use allocation for livestock, wildlife or free roaming horses and burros;

7. The grazing system being used;

8. Physical terrain limitations, access and water sources;

9. Desired vegetation in riparian and/or critical areas is of significant importance to wildlife, fisheries and watershed function.

10. Other public land users.

The importance of climate and weather patterns must also be recognized with a certain flexibility provided for extreme variations in amounts of forage from year to year.

The best measure of proper use and management is the response of the range over a period of time to a comprehensive management system. An experienced range manager can recognize the signs of response and the range trend. Management decisions should then be based upon sound scientific data and analysis.

METHODS AND MATERIALS

Consult with a qualified range management professional in either the private or public sector before establishing a grazing management system. The following are key elements for proper grazing use.

1. Use a comprehensive data form that provides a use record of key forage species each year or grazing season.

2. Keep a record for each grazing unit and make evaluations of use in representative areas of each unit based on species composition and normal grazing patterns in the unit (See Appendix G-3).

3. Maintain a photographic record of range conditions at established photo points.

MAINTENANCE

Maintain proper use by adjusting grazing as indicated by plant response and trend in range condition.

EFFECTIVENESS

Proper grazing use will improve range production and vegetative cover to reduce runoff and sediment delivery.

BMP 7-10
RANGE IMPROVEMENTS

DEFINITION

Improving the existing rangeland through specific treatments including seeding, planting, prescribed burning, and brush/weed management.

PURPOSE

To improve watershed quality, conserve soil and water resources and reduce sediment delivery; produce forage for livestock and wildlife; improve plant species diversity; and improve recreation, wildlife and the natural resource values of the land.

APPLICABILITY

Applies to grazing lands: where the land does not have enough desired plant species diversity to recover in a reasonable period by management alone; where existing vegetation would out compete introduced plant materials; following wildfires or brush management treatment, and where soil, climate, and topography are suitable for establishment of the desired plant community.

PLANNING CRITERIA

Compile the necessary base line data to determine the specific range improvement best suited for the site. Consultation with a qualified range management professional in the private or public sector is recommended.

1. Determine site suitability for seeding or containerized planting - slope, soils, elevation, available moisture, etc.

2. Select species for seeding or planting that are adapted to the site. Mixtures of grasses, forbs, shrubs, etc. are better than single species plantings on most sites.

3. Determine the requirements for acceptable methods of site preparation, soil amendments, planting or seeding.

METHODS AND MATERIALS

The following practices can be utilized to improve rangelands (See Appendix G).

Pasture and Hayland Plantings - Establishing and reestablishing long-term stands of adapted species of perennial, biannual, or reseeding forage plants.

Range Seeding - Establishing adapted plants by seeding on native grazing land.

1. On tillable land, the soil should be tilled with a rangeland plow, chisel plow, or one-way disk. Depth should be as shallow as possible while still eliminating competing vegetation. Double plow if necessary. Perform operations across the slope or on the contour.

2. Pitting or contour furrowing may be used in special situations where complete tillage is not practical or desired, or where other tillage methods would create serious erosion hazards. Chain drags can be used where plowing is not feasible.

3. Tillage operations should leave as much plant residue on the soil surface as possible for seedling protection, moisture conservation and erosion control.

4. Seed with a rangeland drill or, on well-prepared seed beds, a grain drill equipped with agitator and depth regulators. Broadcast seed only on areas that are too rocky or where seeding is not practical for other reasons.

5. Fall or early winter seedings are best. Spring seedings can be used on small areas or sites that remain wet and cold into late spring. (See Cooperative Extension Publication C - 183 for species, mixtures, and seeding rates.)

Critical Area Planting - Planting vegetation, such as trees, shrubs, vines, grasses or legumes on highly erodible or critically eroding areas.

Brush and Weed Management - Managing and manipulating stands of brush and weeds on range, pasture and other areas by mechanical, chemical, biological means or by prescribed burning (See Appendix G-7).

Prescribed Burning - Applying fire to predetermined areas when the intensity and spread of the fire are controlled. (See BMP 6-6, "Prescribed Use of Fire").

MAINTENANCE

1. Seedings must not be grazed until the plants are well established. Usually it is necessary to protect seedings from grazing for one full year and through the growing season of the second year. Some seedings established during adverse weather cycles may need protection for a longer period.

2. After seedings are established, follow established grazing management practices. (See BMP - 7-9 - "Proper Grazing Use" and BMP - 7-8 - "Planned Grazing System")

EFFECTIVENESS

Well established and managed range seedings protect watersheds from excessive runoff, reduce runoff, reduce erosion and sediment delivery.

BMP 7-11
LIVESTOCK FACILITIES

DEFINITION

Livestock containment facilities are structures built or used to hold livestock, including but not limited to: corrals, holding pens, feed lots, barns and sheds.

PURPOSE

To reduce the degradation of surface runoff water quality and the potential to contaminate ground water resources resulting from the confinement of livestock.

APPLICABILITY

Applicable to areas where livestock are concentrated, such as horse corrals, feed yards, and holding pens. Runoff and leachate from these facilities can be high in nutrients from animal feed and manure and create water quality problems especially if located near a streamside management area (SMA) or areas with a high water table.

PLANNING CRITERIA

The siting and construction of livestock containment facilities is important and sites should be carefully chosen based on the following guidelines.

1. Facilities should not be located in or near a SMA .

2. Facilities should not be located in areas subject to overland surface flow or flooding from upslope areas.

3. Facilities should be located on gently sloping to flat land (5% slope or less).

4. Facilities should not be located in areas which have less than four feet from the soil surface to the ground water table at any time of the year or areas having a high leaching potential.

In addition to the proper location of livestock confinement facilities, the following guidelines should be followed:

1. Surface runoff and related discharges from livestock containment facilities should be limited by:

* Storing both the facility wastewater and the runoff from confined animal facilities that is caused by storms up to and including a 25-year, 24 hour frequency storm. Storage structures should:

a. Have a compacted clay seal or plastic membrane lining, or
b. Be constructed with concrete, or
c. Be a storage tank.

* Managing stored runoff and accumulated solids from the facility through an appropriate waste utilization system.

2. Surface runoff from these facilities or animal waste stockpile should not be allowed to flow into a SMA.

3. Stockpiling of animal wastes should be thoroughly investigated for the potential to degrade the soil profile and ground water resources. Any runoff or drainage from animal waste stockpiles or the facility area should be routed to the runoff storage system.

4. Manure storage or animal waste piles should be protected from precipitation and surface runoff.

5. When applied to agricultural lands, manure, stored runoff water, stored facility wastewater, and accumulated solids from the facility are to be applied utilizing appropriate nutrient management measures. An appropriate waste utilization system to minimize impacts to surface water and to protect ground water may be achieved through implementation of the SCS Waste Utilization Practice (633).

6. Anaerobic ponds can be used to reduce odors and solids, improve water quality and generate methane gas.

METHODS AND MATERIALS

Livestock confinement facilities should be located, designed, and constructed under the direction of qualified professionals. If the facility is to be served by vehicle, the site should have loading-unloading areas that are outside of SMAs.

MAINTENANCE

A comprehensive inspection and maintenance program should be developed based upon the specifics of the site. Inspections should be conducted regularly, particularly after precipitation or storm events and repairs made as required.

EFFECTIVENESS

Properly maintained and operated facilities can be effective in preventing the discharge of degraded surface runoff and minimize ground water quality degradation.

FIGURE 7-1 (DAIRY 1)
CONTAMINATION CHART